DOCUMENT RESUME

ED 236 710 CS 504 342

AUTHOR White, Sylvia E.
TITLE The Effect of the Form Complexity of Television on the Identification/Recognition Process.
PUB DATE May 83
NOTE 34p.; Paper presented at the Annual Meeting of the International Communication Association (Dallas, TX, May 26-30, 1983).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Behavioral Science Research; *Cognitive Processes; College Students; Perception Tests; *Recall (Psychology); Research Methodology; *Television Viewing; *Visual Discrimination; Visual Perception; *Visual Stimuli
IDENTIFIERS *Form Complexity

ABSTRACT

To measure how the complexity of a television image affects the viewer's ability to identify or recognize visual details within the image, two coders rated the form complexity of 30 public service announcements, basing their evaluation on the familiarity of the images in the announcements, the rate at which they presented new information, and the number of simultaneous inputs they contained. Subjects, 30 male and 39 female college students, viewed the spots and were asked to identify letters flashed on the screen in a random pattern for varying amounts of time and to memorize visual details from the announcements. A one-way analysis of variance revealed that as form complexity increased, scores in letter identification decreased. Following the experiment, subjects completed a multiple choice test measuring their recall of visual details from the spots. Contrary to expectations, results indicated that as visual complexity increased, subject recall decreased, which suggested that letter identification does not represent a pure measure of processing demands during normal visual recall. Although limited in scope, the findings indicated that highly complex visuals may not be useful for conveying factual information needed for recall. (The coding scheme and tables of data are appended.) (MM)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED236710

The Effect of the Form Complexity of Television on the Identification/Recognition Process

by

Sylvia E. White

Western Illinois University
Department of Communication Arts & Sciences
Macomb, Illinois 61455
(309) 298-2131

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

Paper presented to the Mass Communication Division, International Communication Association Annual Meeting, Dallas, May 1983

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Sylvia E. White

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

CS 504342

The Effect of the Form Complexity of Television on the Identification/Recognition Process

Abstract

This study examined the relationship between the form complexity of the television image and the capacity of the human processer to perform the function of identification/recognition. The findings supported a model of information processing that proposes that the medium modality will have its most direct effect early in the information processing system, at the point of identification/recognition in the sensory register. The uses of a technique for measuring processing capacity within the information processing system is discussed.

The Effect of the Form Complexity of Television on the Identification/Recognition Process

Traditionally, the main thrust of television research has been on its content. Yet focusing on content alone can be misleading (Katz, Blumler, and Gurevitch 1974). The way in which a message is presented may critically influence the way in which the message is interpreted.

The study reported herein takes the position that media modality is an element of the message that is of critical concern and that, in studying the effects of media modality, an information processing approach is a fruitful enterprise. An information processing approach looks at what happens to the information as it passes through the human's cognitive faculties. The more we know about what happens to the information as it passes through the human information processing system, the closer we can come to answering the critical question of why certain elements of media modality have certain effects.

Drawing on the work of Salomon (1979), White (1982) presented the following propositions concerning the study of media modality:

1. The form of a message influences the manner in which people process informatin and extract meaning (p. 5).

2. Equivalence of meaning across media is impossible to achieve (p. 9).

3. Television (like other media) has an inherent code (symbol system) which is unique (p. 10).

4. The form of television's messages is constrained by the unique symbol system of that medium (p. 12).

It seems then that comparing one medium to another is a less useful approach than that of comparing the elements of one particular medium. McCain and White (1980) found that studies of the latter kind yielded more

consistent and specific results.

Suggestions for which elements of the television medium may be compared when examining the effects of the television modality can be found in Salomon (1979). Salomon (1979) indicated that film and/or television (the two can be used synonymously when discussing symbol systems but not when discussing viewing environments) utilizes many symbol systems simultaneously - photography, gesture, speech, dance, music, and some television specific systems as well. He pointed out that television communicates through symbol systems and multiple-symbol-system episodes. Those elements of the symbol system used by television that are unique to that medium are difficult to separate from elements television holds in common with other media. Kjorup (1977: 38) suggested that "no code used by the film medium is specific to this medium," but Salomon (1979) indicated that some of the conventions of composition and transformation used by the television medium (split screen, slow motion, zoom, sequences of interchangeable shots) are unique to television. These elements are a large part of what makes up the physical form of the television message.

The elements of the visual image (zoom, camera angle, cuts, etc.) can occur in numerous combinations and frequencies within one television presentation. The varying degrees to which these elements are used can aid or interfere with information processing (Salomon 1979). The greater the number of these elements that are used, and the faster the pacing or rate of the presentation, the more complicated the message appears to be. A measure of the form complexity of the television image has been developed which is based on the presence or absence of these elements of the visual image (McCain and Book 1976, Padderud 1976). This particular measure of form complexity has been found to correlate very highly with the Watt and Krull (1974) measure of form complexity (McCain et.al. 1978).

Since such elements of the television message can be expected to aid or interfere with information processing (Salomon 1979), it seems that understanding how people process television messages is critical to understanding its uses and effects. Before any information extracted from a television message can have an effect on the individual receiver, that information must pass through the information processing system of the receiver. The modality research that has been done in the past (McCain and White 1980) has, without exception, been designed in accordance with a behavioristic tradition that manipulates the input, observes the output, and treats the process that occurs in between as if it were covered by an opague black box, that is, unknowable. By measuring only an end result of the information processing process, modality researchers run into the problem that the effects of media modality may be obscured by other information already held by the receiver. All the stored knowledge, past experiences and transient emotional urges of the receiver are bound to affect the processing of the information in some way. This may, in fact, be the reason why so many of the findings of modality research are contradictory or inconclusive (McCain and White 1980).

Psychologists are generally agreed that information entering the human mind passes through several identifiable processes before a response to it is made (Klatzky 1975). If the processes through which information passes after entering the human mind can be identified and understood, then we might stand a better chance of finding those effects attributable solely to the media modality. Furthermore, understanding <u>how</u> information is processed (from whatever source) should lead us closer to answering the question of <u>why</u> certain messages have certain effects on certain individuals.

Experimental psychologists have proposed a model of information processing whereby information, following its physical perception, enters into the infor-

mation processing system through both visual and auditory sensory registers. Here the information is held for a few seconds in fairly veridical form until as much as possible can be identified. These identified traces are passed on either to long-term memory, where they may be easily lost in the mass of information already present, or to working memory, where the trace may be strengthened and tagged to other traces in such a way that recall, once it has been passed from working memory to long-term memory, is more easily accomplished (Klatzky 1975).

In reviewing the functions of these three structures, sensory register, working memory, and long-term memory, it appears to be the sensory register that is most directly affected by the modality of the medium. The sensory register is the first structure that input information is proposed to encounter. Any information that makes a successful passage through the physiological receptors is held briefly in a large capacity storage structure. (Egeth 1968).

Separate sensory registers have been suggested for visual input and auditory input (Crowder and Morton 1969), and it is possible that separate sensory registers exist for all different types of sensory input.

The visual sensory register, which Neisser (1967) called "transient iconic memory," can hold information for up to two seconds under ideal conditions. Visual variables such as intensity, exposure time, post-exposure illumination, all have been found to affect iconic memory indicating that the stored image is indeed some sort of visual image (Neisser 1967). Whether or not that visual image is identical to the external input is open to debate. In reviewing several theories of character recognition, Sternberg (1967) found that the trace in iconic memory (or the sensory register) is most likely a refined image or a list of physical features. In either case, what is represented are physical properties of the stimulus.

The auditory sensory register, which Crowder and Morton (1969) have called the precategorical acoustic store, is similar to the visual system but can hold information substantially longer. Some auditory information has been found to be present for up to four seconds after presentation (Darwin, Turvey, and Crowder 1972).

The function of the sensory register is to hold information long enough for identification/recognition to occur and for the information to be passed on to subsequent memory structures (Klatzky 1975). The sensory register apparently makes contact with long-term memory in order to identify the input stimulus. Identification is said to occur by means of template matching (Sternberg 1967) or by means of feature-testing/feature list matching (Smith and Spoehr 1974). Once identification is made, it is the identified trace or name of the stimulus that is passed on to subsequent structures and not a visual or auditory image (Atkinson and Shiffrin 1968). As Travers (1970) noted:

> In the matter of the transmission of sensory information to the higher centers of the brain, one has to keep from imagining that a picture of the outside world somehow arrives at the higher centers and is stored there as a picture. The difficulty of this kind of thinking is as follows. Consider the fact that an image of the outside world is impressed upon the retina. Now suppose that this image is transmitted in an intact form to the cortex of the brain. What happens to it there? Is there a little man in the cortex who then takes a look at this brain picture and interprets it? Does the little man have eyes with retinal images that are in turn, transmitted to his cortex, where another little man . . .? the argument is quite obviously so much nonsense. (Travers 1970: 38)

In sum then, the input stimulus enters the sensory register as some sort of veridical copy of the physical stimulus and remains in such a form until identification is made. Once identification is made, the input stimulus is passed on to subsequent structures in the form of an identified trace.

The sensory register has been shown tobe limited by time. Even under ideal conditions an image in the visual sensory register or iconic memory decays rapidly and is gone by the time two seconds have passed (Atkinson and Shiffrin 1968). An auditory image is maintained longer but is still subject to

rapid decay (Crowder and Morton 1969). Another limitation on the visual sensory register is that a later stimulus may mask or obscure one stored earlier. This effect has been called "backward masking." The post-stimulus exposure field may be said to reduce the useful duration of the image (Neisser 1967). There is some evidence that a similar situation occurs in the precategorical acoustic store (Crowder and Morton 1969).

The actual capacity of the sensory register is probably very large (Klatzky 1975), however information can only be withdrawn from it at a rate consistent with the information processing capacity of the nervous system (Egeth 1967) which Miller (1956) suggested is only seven plus or minus two bits of information. Sperling (1967) demonstrated that the visual sensory register can hold more information than can be transferred into the rest of the system in a simple experiment. He briefly presented three rows of letters to subjects simultaneously. When asked to recall all the letters, subjects could only recall approximately one row of seven letters. However, when he gave subjects an indication, after the presentation, of which row of letters to recall, the subjects were able to recall any one row with ease. Apparently, subjects were able to choose which row to process. All rows had to have been available in the sensory register, though only one could be processed and recalled.

When the above information about the sensory register is taken into account, it seems likely that the physical form of the medium will have its direct effect at the identification/recognition process located in the sensory register.

First of all, when talking about media modality the emphasis is on the physical structure of the stimulus, i.e., how information is being presented. It is necessary, therefore, to find a point in the information processing system where elements of the physical structure of the stimulus are important. If we follow the stimulus, say a television image, into the system, we find that in the first structure to be encountered, the sensory register, the information is stored in a fairly veridical form (Sternberg 1967). This refined image or

feature list is then compared to stored traces in long-term memory until identification/recognition of the television image is achieved (Sternberg 1967, Smith and Spoehr 1974). Once a match is found, it is the identified trace or the name of the television image which is passed on to subsequent structures (Atkinson and Shiffrin 1968).

This identified trace comes from long-term memory, and while it may be in a visual code (Meyer, Schvaneveldt, and Ruddy 1974), it is not identical to the image originally stored in the sensory register. It now comprises as much already stored information as incoming, new information.

The end result is that the elements of media modality should have little or no direct effect on processing after identification/recognition is made. The less familiar the television images are, the more likely identificatoin will be difficult or incomplete and the more likely that elements of the physical form will have to be retained. The more familiar the televised images are, the morew the viewer can rely on already existing memory traces and forget the actual physical form of what s/he has just seen.

It seems, therefore, that it is the process of identification/recognition that is most likely to be directly affected by media modality. According to Tulving and Tbomson (1973: 369) the "specific encoding operations performed on what is perceived determines what is stored, and what is stored determines what retrieval cues are effective in providing access to what is stored." In the same way, the encoding of the incoming image determines what memory traces are activated and what connections between memory traces are made. In short, the greatest effect that media modality could have on identification/recognition seems to be in which particular long-term memory trace(s) will be stimulated to provide identification/recognition. While the identification/recognition of media content presented over varying modalities will be similar in most cases; direct translation from one medium to the next may not be possible simply because the physical form of the incoming information causes slightly

different long-term memory traces to be activated and slightly different associations among memory traces to occur. Media modality, therefore, affects the first step in a long line of effect; i.e., identification/recognition depends on media modality and content, and subsequent processing depends partly on what identification has been made.

One way of examining the process of identification/recognition is to look at the sensory register's capacity for performing that function. Capacity is defined as the "amount of information that the human can process as determined by the physiological and psychological limits inherent in him or the situation" (Travers 1970: 74). There are going to be elements of the televised image that will make identification/recognition easier or harder and therefore take up more or less of the available capacity. Travers (1970) indicated that up to the point of identification/recognition, a large amount of information can be processed at once; at the point of and after identification/recognition, only one bit of information can be processed at a time.

Some elements of the image which can affect the ease of identification/recognition are: familiarity, rate and the number of simultaneous inputs. Familiarity refers to how often in the past the viewer has encountered the same or similar image. The more familiar a viewer is with a type of image, the more well integrated memory traces concerning that type of image will be in long-term memory. The more well integrated memory traces in long-term memory are, the stronger the traces will be (Waugh and Norman 1965) or the more efficient retrieval instructions/pathways will be (Slamecka 1968). The stronger the memory trace or the more efficient the retrieval process, the quicker and easier search through long-term memory will be (Klatzky 1975). The easier and quicker the search in long-term memory, the easier and quicker the process of identification/recognition will be and the lower the capacity requirements.

Familiarity with media modality can be measured and is a characteristic of the viewer. Someone who is television naive is certainly less familiar with that medium than is someone who watches all the time. Certain special effects, odd camera angles, etc. are less familiar to viewers than normal shots, which match as closely as possible ordinary sight. The McCain and Book (1976) measure of form complexity counts a television image as more complex when the camera angle is abnormal.

A second element of the image that can affect the ease of identification/recognition is that of rate. The sensory register is limited severely by time: iconic memory can only hold information for up to two seconds under ideal conditions (Neisser 1967), and the precategorical acoustic store can only hold information for up to four seconds also under ideal conditions (Crowder and Morton 1969). The slower information is input into the system, without overtaxing the sensory register's ability to hold it, the more time there is for "proper" identification/recognition to occur. However, new information tends to arrive at much greater speeds than every two or four seconds. The faster it arrives, the greater the strain on capacity.

The speed of information input or rate can be measured and is an element of media modality. For example, in reading, the reader usually controls the rate of input him/herself. In television viewing, the rate is fixed by the medium. Perhaps that is one reason why print seems to be better than film for the purposes of learning (McCain and White 1980). The reader in the print circumstance is able to optimize the rate of input for his/her own system. In television viewing, the rate is fixed and may not be optimal for that viewer. Yet even television presentations vary in rate, and this should be considered when examining modality effects. The McCain and Book (1976) measure of form complexity counts a television image as more complex as the amount of movement increases and the frequency of cuts increases.

A third element of the image that can make identification/recognition easier or harder is that of how many different stimuli arrive simultaneously. While the sensory register can take in a large amount of information at once and hold it for a short time (Sperling 1967), the ability of the organism to identify and process this information is severly limited (Travers 1970).

The number of simultaneous inputs is also a characteristic of the media modality and can be accounted for simply by recording the amount of background detail, and, in the case of television, the number of activities going on at the same time. For example, there is a considerable difference in background detail between a "talking head" shot in a television news program and a scene of a man walking through a busy city intersection. The more cluttered the shot the greater the burden on the capacity of the sensory register to process the information. The McCain and Book (1976) measure of form complexity counts an image as more complex the longer the shot and the more things located in the background.

It is probably wise at this point to summarize the aspects of modality research and the information processing model that have been discussed up to now. First, it has been pointed out that it is probably best, when trying to measure the effect of the physical form of the medium, to compare elements of one medium rather than to compare two different media. It may be that different media are simply not comparable.

Secondly, various elements of the television/film medium that are unique to that medium have been described. They are elements in the production of the visual television image such as cuts, zooms, camera angle, camera movement, distance of shot, etc.. When looking at the effect of the form of television or film, these should prove useful elements for comparison.

In examining the functions of the various structures of the human information processing system, it has been proposed that the first and most direct effect of the physical form of the medium would have to be in the sensory register. This is the first structure the incoming image encounters and it

is here that the images are identified and named. What is passed on to the higher mental processes is an identified trace.

It has been noted that the capacity of the sensory register to perform the function of identification/recognition is limited by the familiarity of the incoming image, the rate of input, and the number of simultaneous inputs.

If this model is correct, and it is the case that the physical form of the incoming television image will have a direct effect on the identification/recognition process that occurs in the sensory register, then it should be possible to test this model by measuring the effect of the physical form of the television image at the point of recognition.

The elements of the television image to be compared have already been suggested. It has also been noted that the McCain and Book (1976) measure of form complexity uses just those elements in determining the complexity of a televised image. Furthermore, it has been seen that the elements of familiarity (which can be measured as unusual camera angles, special effects), rate (which can be measured as the frequency of cuts, amount of movement), and the number of simultaneous inputs (which can be measured as the closeness of the shot and the amount of detail in the background) are all proposed to affect the ability of the sensory register to perform its functions, and these are again the same elements that the McCain and Book (1976) measure of form complexity uses.

It seems logical then to predict that the greater the form complexity of the television image, the more difficult the process of identification/recognition will be. Form complexity can be measured using the McCain and Book (1976) system. What remains necessary for the testing of this information processing model is a way to measure the difficulty of the identification/recognition process in the sensory register while televised images are being input.

In the past, measures of the effect of the modality of the medium have relied on after-the-fact or end of process indicators, such as recall, learning attitude change, etc. (McCain and White 1980). In order to measure the effect of the complexity of the television image on the process of identification/recognition, it is necessary to measure processing as it occurs rather than after the fact. One aspect of information processing that has been found to be measurable at virtually any point in the information processing system is that of processing capacity (Kerr 1973). Recall that capacity is defined as "the amount of information that the human can process as determined by the physiological and psychological limits inherent in him or the situation." (Travers 1970: 74). There is a limit on the capacity of the sensory register to perform identification/recognition (Sperling 1967). The more difficult the process of identification/recognition is, the more of the limited amount of capacity available that will be used.

It is not possible to measure capacity directly. However, indirect methods of measuring capacity have been devised. One of the most widely used methods of measuring processing capacity is called the "secondary task technique." Use of the secondary task technique to measure capacity evolved from previous research which examined the ability of people to perform two simultaneous tasks. From these earlier studies researchers developed the idea that scores on one task might be used to measure processing demands for another task (Kerr 1973).

This technique is characterized by:

> an experimental situation in which two discrete and separate tasks are performed concurrently with a clear emphasis on the performance of one of the tasks. This emphasis on one task, the primary task, is induced bny instructions or by a performance-contingent reward structure (Ogden, Levine, and Eisner 1079: 530)

First, a primary task is identified. This is the task of greatest interest. In the present case it is the ability of the person to perform the process of identification/recognition as the complexity of the televised image varies. It is impossible to measure the primary task directly as it is occurring.

Often, the primary task is of such a nature that only after-the-fact or "product" measures may be taken. These would be measures of the end result of processing, such as knowledge gain and recall, and would tell nothing about what goes on during processing.

A second task, called the secondary task, is chosen which taps the same process as the primary task. In the present case that would be the identification/recognition process. Both tasks are to be performed simultaneously. Together both tasks must exceed the capacity of the information processing structure. In the present case, that means that both tasks could not be performed to perfection at the same time. Pre-tests of both tasks are needed to show that each could be performed better given more capacity. This can be done by testing the ability of the person to perform the secondary task alone and together with the primary task. Performance on the secondary task alone should be better than that when combined with the primary task. The primary task can varied according to levels of difficulty and performance on the secondary task (which never varies in difficulty) used to infer the relative differences in the processing demands of the primary task conditions. More detailed explanations of the secondary task technique and its theoretical justification can be found in Kerr (1973), Norman and Bobrow (1975), Navon and Gopher (1979) and White (1982).

Using the secondary task technique, a simple experiment was designed to measure the effect of the complexity of the televison image on the capacity of the sensory register to perform identification/recognition.

Measures

The first step in the preparation of the experiment was to choose appropriate stimulus material. Thirty public service announcements on 16 millimeter film were available. All 30 of these announcements were more than two years old and had been donated by local television stations. It was decided that these

public service announcements were appropriate stimulus material as they were representative of normally occurring television content.

Each public service announcement was coded for form complexity using the procedures developed in McCain and Book (1976) and Padderud (1976). In this system, the more subject movement, camera movement, the faster the cutting rate, the smaller the image size, the more unusual the camera angle, and the greater the background complexity the more complex the television commercial is judged to be (the actual coding categories appear at the end of the paper). When using this measurement technique, each of the six areas that go into the measure of complexity receive scores of 0, 1, 2, or 3. The unit of analysis is up to the discretion of the experimentor; in the present study is was every five second segment of each public service announcement. An average score is then taken for each spot.

Each of the 30 public service announcements available for use in the experiment was coded for complexity using this measurement scheme by two coders. Before beginning to code the public service announcements, the coders coded a "Nyquil" commercial together, discussing each category and reaching agreement before a code was assigned. Following this familiarization process, each coder coded the public service announcements individually. Overall intercoder reliability was .83.

After coding was completed, the 30 public service announcements were ranked according to overall complexity. Five spots were chosen from those with the highest complexity scores, five spots were chosen from those with the lowest complexity scores, and five spots were chosen from the center of the complexity range. These three sets of five spots were chosen to constitute three stimulus conditions for the experiment: low complexity set, moderate complexity set, and high complexity set. In addition, five spots were chosen randomly from the public service announcements left over to consitute a practive set for the

experiment. Table 1 shows the complexity scores for each public service announcement in each stimulus set.

Insert Table 1 about here

A secondary task was then developed that would tap the identification/recognition process and be measurable. The task chosen was one which required the detection and identification of visual information.

The secondary task chosen for the experiment asked the subject to distinguish between two visually similiar pairs of letters: E and F, and G and C. The letters appeared one at a time on the television screen edited over the public service announcements. Each time a letter appeared, the subject had to decide whether s/he had seen an E/C or an F/G. Several pre-tests were performed to determine the number of identifications to appear per public service, the visible duration and size of the letters, and that the letter identification task in combination with the task of processing the public service announcements would exceed the capacity of the subject to perform both tasks perfectly. These pre-tests are reported in detail in White (1982).

The letters were shown on a 12" X 16" television screen over the playing of a public service announcement for a visible duration of 67 milliseconds. Each letter was encased in a solid color square to help prevent the lightness or darkness of the public service announcement from interfering with the identification. On the television screen, the letters appeared to be white encased in a dark purple square. The size of the letters and squares on the television screen was one and one-half inches. The letters appeared at random intervals with the average interval being 2.5 seconds.

The location of the letters on the television screen itself also varied randomly among nine quadrants: 1. upper left, 2. upper middle, 3. upper right, 4. middle left, 5. middle middle, 6. middle right, 7. lower left, 8. lower middle, and 9. lower right. These quadrants divided the television screen in two dimensions: from right to left, and from top to bottom.

Each subject was run individually and was instructed to look for the letters and respond in the following manner. On the arms of the chair in which each subject sat while viewing the public service announcements were two response boxes. Each box contained a spring-loaded lever. Subjects were instructed to pull the left hand lever if they thought they saw an E or a C; and to pull the right hand lever if they thought they saw an F or a G. Each lever was connected to a colored light in a separate room out of view of the subject. An observer in this room recorded each subject's responses to this task by observing the activity of the lights. Also, the observer listened to a separate audio track of the video tape wherein a tone sounded for each appearance of a letter. In this way, missed detections could be recorded. Subject scores on this letter identification task were recorded as the percent of correct responses.

Subjects were seated approximately 60" away from the television screen in a room with normal room lighting. The subject's task was two-fold: 1. to detect that a letter had appeared, and 2. to determine which of two visually similar letters appeared.

At the same time that they were performing this task, subjects were attempting to memorize visual details from the public service announcements. Subjects were informed at the beginning of the experiment that they should put their greatest effort into memorizing visual details from the public service announcements. After viewing each set of public service announcements, the subjects were asked to fill out a questionnaire containing multiple-choice questions concerning visual details of the spots they had just seen. In choosing the topics to be included in the questions, one important criterion was followed: the topics should be primarily visual in nature; it should not be possible to answer the questions based on auditory recall. In the past many studies have been done examining the effect of color on recall and comprehension (McCain and

White 1980), therefore, the color of things was one of the topics used in the questions. Subjects were asked to recall the color of people's hair, clothing, walls, signs and other things in the background or being used by the peopel in the public service announcements. Past studies of modality effects (McCain and White 1980) have also dealt with background complexity. Such measures have often included details about what the subject recalls seeing in the background, etc.. In the present study, questions were asked concerning approximate numbers of things (i.e., one duck, three - five ducks, 10 - 20 ducks swimming by), types of clothing and accessories (i.e., scarves, glasses, earrings, hats, etc.), items in the background (towels, clothes hanging on pegs, taxi cabs, etc.), and where people are (sitting at a desk, standing in a kitchen, outside in the woods, etc.). The actual questions used appear in the appendix of White (1982).

This can be considered a measure of the primary task, that of the processing of the televised content. The subjects were instructed to emphasize this task to the detriment, if necessary, of the letter identification task. Performance on this visual recall task should not vary across levels of form complexity, while performance on the letter identification task should vary if form complexity really does affect the capacity of the subject to process the incoming information.

Procedures

A counter-balanced design (see Campbell and Stanley 1963) was used for this experiment, wherein each subject was exposed to all stimulus conditions: High complexity, moderate complexity, and low complexity. However, the ordering of the three conditions was varied into three groupings: One third of the subjects saw the low complexity condition first, then the moderate complexity condition, and then the high complexity condition. One third saw the moderate complexity condition first, then the high complexity condition, and then the low complexity. And one third saw the high complexity condition first, then the low complexity condition, and then the med complexity

condition.

This design had a distinct advantage in the present experiment: differences in performance between complexity conditions could not be interpreted as resulting from individual differences, as each subject experienced each stimulus condition. It was not known whether subjects would have significant individual differences in their visual processing capability, therefore it was desirable to eliminate this possible confounding variable from the experiement. Each subject was assigned to one of the three groupings independently and at random.

The following is a description of how the experiment proceeded. Each subject was run separately. The subject was told what to expect in the experiment and saw a training videotape. This videotape taught them hjow to perform the letter identification task and gave them an idea of the types of questions to be asked in the visual recall task. The subjects were instructed to perform the visual recall task to the best of their ability at all times. They were told that the letter identification task should not be allowed to interfere with their performance on the visual recall task. The subjects then got a chance to practice both tasks in a trial run of the experimental procedure. After the practice set, subjects saw each stimulus condition (while performing the letter identification task) and answered visual recall questions after each condition. The experiment took approximately 45 minutes to complete per subject.

Subjects

The subjects used in this experiment were 69 students from an introductory mass communicatoin course. Thirty were female and 39 were male. Ages ranged from 18 to 46, with the average age being 20 years.

Hypothesis

The greater the complexity of the television image, the lower the score on the ~~visual recall task~~ letter id task, was the first prediction. The second prediction

was that scores on the visual recall task will not vary with the level of complexity of the television image.

Results

A one-way analysis of variance with repeated measures was performed to test the prediction that as complexity increases, scores in the letter identification task will decrease. The mean score on the letter identification task overall was 57.75% correct responses (standard deviation = 18.29).

The results of the analysis of variance indicate that a significant difference does occur in the letter identification task scores depending on the level of complexity of the public service announcements. Table 2 shows the results of this analysis.($F = 49.37$, $p = .01$).

Insert Table 2 about here

An examination of the mean letter identification task performance for each level of complexity (see Table 3) indicates the greater the complexity of the television image the lower were the scores in the letter identification task. Mean performance on the letter identification task in the high complexity condition was 53% correct, in the moderate complexity condition was 57% correct, and in the low complexity condition was 63% correct. A follow-up t-test (Tukey HSD) indicated that high complexity was significantly different from low complexity but that moderate complexity was not significantly different from either high or low complexity.

Insert Table 3 about here

The eta^2 measure for between measures indicated that only 5% of the variance was explained by complexity while 87% of the variance was explained by individual differences between subjects. These extreme between subject differences were probably due to differences in hand-eye coordination, information processing efficiency and various personality characteristics. Such a result was not

unexpected and was the reason why each subject was exposed to each condition and a repeated measures analysis used. Also, there is no interest in predicting raw performance on a letter identificatoin task. The interest is only in the relative differences in that task between levels of complexity in the televised stimulus.

Theoretically, in an experiment using the secondary task technique, the scores on the primary task (visual recall task) are not supposed to change across levels of the primary task difficulty (see Kerr 1973). An analysis of the visual recall task scores was performed to see if the data in this experiment conform to theory.

The primary task score was measured as the percent of correct responses each subject made to the visual recall questions. A one-way analysis of variance with repeated measures was performed on the visual recall task scores by the level of complexity of the public service announcements. The mean score on the visual recall task overall was 57.82% correct (standard deviation = 15.59).

The results of the analysis of variance indicate that a significant change in the visual recall task scores did occur across levels of complexity. This analysis appears in Table 4, ($F = 32.41$, $p = .01$).

Insert Table 4 about here

It appears that the higher thelevel of complexity in the sets of public service announcements, the lower scores on the visual recall task were. Table 5 shows the mean visual recall task scores for each level of complexity. Mean visual recall scores for high complexity was 48% correct, for moderate complexity was 60% correct, and for low complexity was 65% correct. A follow-up t-test (Tukey HSD) indicated that high complexity scores were significantly lower than either moderate or low complexity scores, but that low and moderate complexity scores did not differ significantly from each other.

Insert Table 5 about here

In sum then, the prediction that as complexity increases, scores on the letter identification task will decrease was supported in the data analysis. Contrary to predictions, there was a variation in scores on the visual recall task across levels of stimulus complexity. To the extent that scores on the letter identification task and ratings of the difficulty of the visual recall task validly reflect capacity demand, then it can be concluded that increased form complexity in the televised content did indeed create a greater deman on the capacity of the system to perform the identificatoin/recognition function. The model proposed to explain modality effects was supported, therefore, in this respect. Further, there seems to be something especially difficult in the visual recall task in the high complexity situation.

Discussion

In terms of the study reported herein, the form complexity of the public service announcements was proposed to affect the ease of the identification/recognition process in the sensory register. This proposal was tested in an attempt to verify that elements of the television modality would have a direct effect early in the information processing system, specifically, at the point of identification/recognition in the sensory register.

In the analysis, it was found that as the complexity of the television image increased, performance on the letter identification task decreased. This finding is interpreted to mean that increased visual complexity leads to increased capacity demand in the identification process. This, in turn, supports the idea that the capacity of the organism to perform identification and to process information is limited.

If, in fact, the human processer <u>does</u> have to "work harder" in accordance with the level of visual complexity of the televised image, this indicates that the physical form of the television image <u>does</u> have a direct effect early in the

information processing system. Visual complexity should effect which memory traces are linked to which input for purposes of identification, and how much time the viewer had to identify each new input, that is, how hastily each identification must be. It also follows that the choice of memory traces will affect subsequent processing and eventually the viewer's interpretation of what has been seen.

It was also found that scores on the visual recall task fell drastically in the high complexity condition. Theoretically, scores on the visual recall task were supposed to remain constant across all levels of complexity (Kerr 1973) That they did not remain constant, prevents the assumption that letter identification task scores represent a pure measure of processing demands during normal visual recall task performance (Kerr 1973). While, under ideal conditions, the letter identification task score could be used to determine exact amounts of capacity use change over levels of complexity, in the present situation, only an ordinal conclusion could be reached, i.e., high complexity uses more capacity than low complexity does; how much more is not determinable.

On the other hand, although only ordinal conclusions are possible, we are still able to conclude tha t the visual complexity of the television image does affect the identification/recognition function of information processing. Also, the fact that only the high complexity condition was thus affected may prove interesting in and of itself.

Vitz (1966) found that a very complex display may be so difficult to structure that it communicates no information at all. The subject, in the circumstance described, may be so overwhelmed by the task of maintaining performance on the visual recall task while performing the letter identificaion task that s/he either gives up completely or vital capacity is wasted by anxiety.

If this is the case, it has some interesting implications for television research. For one thing, it suggests that highly complex visuals may not be ideal for learning purposes. This does not mean that such presentations

may not be aesthetically pleasing or emotionally arousing. It simply means that they are not useful for conveying factual information that needs to be recalled.

The study reported herein is limited in scope. It only deals with the effect of visual complexity on the identification process. Crowder and Morton (1969) indicated that separate sensory registers may exist for auditory input. Television is also an auditory medium and another study of the same design is needed to determine the effect in the auditory sensory register.

In addition to measuring auditory modality effects, the effect of medium modality needs to be followed through the information processing system to see how the effect becomes modified or attenuated. the effect at identification/ recognition is only the beginning of the process.

REFERENCES

Atkinson, R.C. and Shiffrin, R.M. "Human Memory: A Proposed System and Its Control Processes" in K.W. Spence and J.T. Spence (Eds.) The Psychology of Learning and Motivation Vol. 2 New York: Academic Press 1963

Campbell, D.T. and Stanley, J.C. Experimental and Quasi-Experimental Designs for Research Chicago: Rand McNally College Publishing Company 1963

Crowder, R.G. and Morton, J. "Precategorical Acoustic Storage (PAS)" Perception and Psychophysics Vol. 5 1969

Darwin, C.T., Turvey, M.T., and Crowder, R.G. "An Auditory Analogue of the Sperling Partial Report Procedure: Evidence for Brief Auditory Storage" Cognitive Psychology Vol. 3 1972

Egeth, H. "Selective Attention" Psychological Bulletin Vol. 67 1967

Katz, E., Blumler, J.G., and Gurevitch, M. "Utilization of Mass Communication by the Individual" in J.G. Blumler and E. Katz (Eds.) The Uses of Mass Communication Vol. 3 in the Sage Annual Reviews of Communication Research Beverly Hills: Sage Publications 1974

Kerr, B. "Processing Demands During Mental Operations" Memory and Cognition Vol. 1 1973

Kjorup, S. "Film as a Meeting Place of Multiple Codes" in D. Perkins and B. Leondar (Eds.) The Arts and Cognition Baltimore: Johns Hopkins University Press 1977

Klatzky, R.L. Human Memory: Structures and Processes San Francisco: W.H. Freeman and Company 1975

McCain, T.A. and Book, T.J. "Nonverbal Complexity in Television Commercials: A Markovian Analysis of the Stability of Production Variables" Unpublished Paper Department of Communication The Ohio State University 1976

McCain, T.A. and White, S.E. "Channel Effects and Nonverbal Properties of Media Messages: A State of the Art Review" ERIC ED 194 937 1980

Meyer, D.E., Schvaneveldt, R.W., and Ruddy, M.G. "Functions of Graphemic and Phonemic Codes in Visual Word-Recognition" Memory and Cognition Vol. 2 1974

Miller, G.A. "the Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information" Psychological Review Vol. 63 1956

Navon, D. and Gopher, D. "ON the Economy of the Human-Processing System" Psychological Review Vol. 86 1979

Neisser, U. "Iconic Storage and Verbal Coding" In Cognitive Psychology New York: Appleton-Century-Crofts 1967

Norman, D.A. and Bobrow, D.G. "On Data-Limited and Resource-Limited Processes" Cognitive Psychology Vol. 7 1975

Ogden, G.D., Levine, J.M., and Eisner, E.J. "Measurement of Workload by Secondary Tasks" Human Factors October 1979

Padderud, A.B. "A Process Analysis of the Relationship Between Form Complexity and Viewer Perceptions of a Televised Message" Doctoral Dissertation The Ohio State University 1976

Salomon, G. Interaction of Media, Cognition, and Learning San Francisco: Jossey-Bass 1979

Slamecka, N.J. "An Examination of Trace Storage in Free Recall" Journal of Experimental Psychology Vol. 76 1968

Smith, E.E. and Spoehr, K.T. "The Perception of Printed English: A Theoretical Perspective" in B.H. Kantowitz (Ed.) Human Information Processing: Tutorials in Performance and Cognition Potomac, Maryland: Erlbaum Press 1974

Sperling, G. "Successive Approximations to a Model for Short-Term Memory" Acta Psychologia Vol. 27 1967

Sternberg, S. "Two Operations in Character Recognition: Some Evidence from RT Measurement" Perception and Psychophysics Vol. 2 1967

Travers, R.M.W. Man's Information System: A Primer for Media Specialists and Educational Technologists Scranton, Pennsylvania: Chandler Publishing Company 1970

Tulving, E. and Thomson, D.M. "Encoding Specificity and Retrieval Processes in Episodic Memory" Psychological Review Vol. 80 1973

Vitz, P.C. "Preference for Different Amounts of Visual Complexity" Behavioral Science Vol. 11 1966

Watt, J.H. Jr. and Krull, R. "An Information Theory Measure for Television Viewing" Communication Research Vol. 1 1974

Waugh, N.C. and Norman, D.A. "Primary Memory" Psychological Review Vol. 72 1965

White, S.E. "The Effect of the Form Complexity of Television on the Identification/Recognition Process: An Examination of the Symbol System of Television" Doctoral Dissertation The Ohio State University 1982

TABLE 1

Complexity Scores for the Public Service Announcements Used in the Experiment

Public Service Announcements	Dynamic Complexity	Static Complexity	Overall Complexity
High Complexity Set			
Hire the Handicapped	7.00	7.75	14.75
Apprenticeship Spot	6.33	7.66	13.99
Muscle Disease Spot	7.60	6.40	14.00
Small Business Spot	7.00	7.00	14.00
Veteran's Administration Spot	6.75	6.25	13.00
Average High Complexity Set	6.94	7.01	13.95
Moderate Complexity Set			
Duck Sanctuary Spot	5.00	5.20	10.20
CARE Spot	4.75	5.00	9.75
High Blood Pressure Spot	4.00	5.00	9.00
Retirement Spot	4.00	5.00	9.00
FHA Loan Spot	4.50	3.50	8.00
Average Moderate Complexity Set	4.45	4.74	9.19
Low Complexity Set			
Birth Control Spot	3.60	3.00	6.60
Custom's Spot	2.50	3.50	6.00
Physically Disabled Spot	1.00	3.00	4.00
Energy Conservation Spot	2.16	4.00	6.16
Social Security Spot	3.66	3.33	6.99
Average Low Complexity Set	2.58	3.37	5.95
Practice Set			
Fire Prevention Spot	3.16	3.83	7.00
President's Physical Fitness Spot	3.60	4.00	7.60
Measles Spot	5.75	7.00	12.75
Direct Deposit Spot	3.50	3.50	7.00
Football Spot	7.00	7.00	14.00
Average Practice Set	4.60	5.07	9.67

TABLE 2

ANOVA with Repeated Measures of the Letter Identification Task Scores* by the Level of Complexity of the Public Service Announcements

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-ratio	Probability
Between People	68	60085.60	883.61		
Within People	138	8813.33	63.86		
Between Measures	2	3707.14	1853.57	49.37	.01
Residual	136	5106.19	37.55		
Total	206	68898.94	334.46		

* measured as the percent of correct identifications
eta ^{2} for between measures = .0538, eta^2 for between people = .872

TABLE 3

Means and Standard Deviations of the Letter Identification Task Scores* by the Level of Complexity of the Public Service Announcements

	Mean	Standard Deviation
High Complexity	53.14	17.99
Moderate Complexity	56.74	18.21
Low Complexity	63.36	17.42

* measured as the percent of correct identifications
Tukey HSD critical value is less than 10.21, greater than 6.62

TABLE 4

ANOVA with Repeated Measures of the Visual Recall Task Scores* by the Level of Complexity of the Public Service Announcements

Source	Degrees of Freedom	Sum of Squares	Mean Square	F-ratio	Probability
Between People	68	18221.72	267.97		
Within People	138	31864.67	230.83		
Between Measures	2	10282.24	5141.12	32.41	.01
Residual	136	21572.43	158.62		
Total	206	50076.39	243.09		

* measured as the percent correct on the visual recall task
eta^2 for between measures =.2053, eta^2 for between people = .364

TABLE 5

Means and Standard Deviations of the Visual Recall Task Scores* by the Level of Complexity of the Public Service Announcements

	Mean	Standard Deviation
High Complexity	48.30	13.69
Moderate Complexity	60.01	13.20
Low Complexity	65.14	14.95

* measured as the percent correct on the visual recall task
Tukey HSD critical value is less than 11.71 and greater than 5.13

Coding Scheme for McCain, Book (1976), Padderud (1976) Measure of Form Complexity

Dynamic Complexity

a. Subject Movement - the amount of movement made by the subject within the frame, subjects could be either people or objects.

0 = no movement - the subject or subjects in the frame exhibit no movement during the predominant portion of the interval.

1 = low movement - human subjects in frame exhibit slight movement (e. g., gestures or other manipulation of body) without changing position within the frame. Objects exhibit manipulation of parts (e. g., car or truck doors being opened or closed) without changing position within the frame.

2 = moderate movement - human subjects change position in frame at moderate rate (e. g., walked) or exhibit pronounced gesturing or manipulation of body without changing position within the frame. Objects show moderate change of position within frame (e. g., cars or trucks moving slowly forward or backward).

3 = extreme movement - human subjects change position in frame at extreme rate (e. g., running) or change position in frame at moderate rate combined with pronounced gesturing or manipulation of body. Objects show extreme movement within frame (e. g., cars and trucks moving at high speed).

b. Camera Movement - the frequency and/or strength of panning, tilting, zooming, or other camera manipulations.

0 = no movement - camera remains static during predominant portion of the interval.

1 = low movement - alight camera movement employed to keep subjects framed up or to slightly alter focus of attention in scene.

2 = moderate movement - pronounced camera movement employed to follow subjects walking or driving, or noticable zooming in or out to focus attention or give overview of the scene.

3 = extreme movement - camera is panned, tilted, zoomed, or manipulated in combinations of the above movements to follow rapidly moving subjects or to focus attention quickly on particular portions of the scene.

c. Cutting Rate - the number of cuts within a given interval.

0 = no cuts in interval.

1 = one cut in interval.

2 = two cuts in interval.

3 = three or more cuts in interval.

(Padderud 1976: 47-48)

Static Complexity

a. Image Size - the size of the image within the frame defined by the type of shot used.

0 = no image on screen, [blank as when addresses and credits appear].

1 = close-up shot - a shot of a human subject in which the area from the waist to the top of the head fills the frame, or any shot tighter than this. A shot of an object that takes in approximately the same area (3 feet or less).

2 = medium shot - a shot of a human or group of human subjects in which the entire body from feet to head occupies the height of the frame, or any shot tighter up to the criteria for a close-up. A shot of an object that takes in approximately the same area (3-7 feet).

3 = long shot - any shot which is wider than the criteria for a medium shot on either humans or objects.

b. Camera Perspective - the degree to which the camera is shooting from a normal -- horizontal and standing human eye-level-perspective.

0 = no image on screen, [blank as when addresses and credits appear].

1 = normal perspective - shot is taken on horizontal plane at the height of the eyes of a normal standing adult human.

2 = abnormal perspective - shot is taken with slight vertical skew (i. e., horizon is not on horizontal plane in frame) or is taken from position slightly higher or lower than eyes of normal standing human adult.

3 = extreme abnormal perspective - shot is taken with a great degree of vertical skew and/or position extremely different from that of eye-level of normal standing adult human (e. g., on ground shooting up or from high position shooting down).

c. Background Complexity - the intricacy of the background or area surrounding the subject of the shot.

0 = no image on the screen, [blank as when addresses and credits appear].

1 = low intricacy - simple background such as wall, drape, or sky, which contributes little information to the scene.

2 = moderate intricacy = a background containing a moderate degree of contrast and/or detail, such as the front of a house, some trees, or the side of a vehicle, which contribute additional information to the scene.

3 = high intricacy - a complex background containing a great diversity in contrast and detail such as the appearance of many different types of objects (e. g., trees, buildings, vehicles, etc.) or background objects which exhibit a degree of movement (e. g., traffic, smoke and fire).

(Padderud 1976: 48-49)